4.2 Implications for Management

4.21 The Commercial Value of Studies on Fish Behaviour with Particular Reference to Lake Victoria

R. S. A. Beauchamp *

0. INTRODUCTION

Though it may not be necessary for fishermen to have a detailed knowledge of the behaviour of fish it is likely that the more they know about the habits of the fish they are hunting the more successful they will be. To increase the efficiency of fishermen is not, however, the sole reason for undertaking studies on behaviour.

Such studies are carried out by Research Officers who are seeking information which will enable them to give sound advice concerning the proper management of the particular fishery with which they are concerned. In all cases the aim must be to utilise existing stocks of fish efficiently and economically without waste. Adequate numbers of fish must be left to breed and young fish must be allowed to grow to a commercially valuable size.

Fishery management based on information derived only from statistical analyses of catch records is likely to give rise to restrictive legislation and the need for such legislation may only become apparent after the stocks have been seriously depleted. On the other hand, it can be shown that such analyses, backed by knowledge of the behaviour of the fish, can lead to the framing of more enlightened and often less restrictive legislation. Moreover, in some cases knowledge of the habits of the fish may make it possible to introduce control measures at an early date and so forestall the need for drastic restrictions later on.

The development of a fishery is too often taken as meaning its further exploitation without adequate compensatory measures to maintain the stocks of fish. Research should aim at something better and it can be shown that knowledge of the habits of the fish may make it possible to devise measures to increase the stocks of fish and so develop the fishery in the true sense.

In support of the above remarks on the value of behaviour studies, some notes on the habits of fish in Lake Victoria are appended.

1. TILAPIA

In Lake Victoria, particularly along certain coastlines, suitable spawning grounds for *Tilapia* are limited in extent owing to the growth of papyrus over the littoral. The areas in which *Tilapia* breeds have moderately firm substrate, suitable for nest building. The males build the nests and remain for several weeks guarding them and attracting females to spawn in them. Females usually come to the actual spawing grounds only when fully ripe and leave soon afterwards with the fertilised eggs in their mouths.

Fishing over the spawning grounds leads to the capture of a high proportion of males and to the destruction of ripe females and females carrying entire batches of fertilised eggs. While it is impracticable to prohibit gillnetting over the spawning grounds it is clear that seine netting over these grounds should be discouraged, because not only are breeding fish captured but the substrate essential for nest building may be damaged and existing nests destroyed.

It is natural for fishermen to wish to use seine nets, yet in many areas of the lake the only coastal areas sufficiently free from vegetation for seine netting, are those used by *Tilapia* for spawning. There is therefore unequivocal evidence for restricting the use of seine nets in those areas where *Tilapia* are predominant. (There are, of course, other areas along the more exposed coastlines where fish other than *Tilapia* are more numerous and where the use of seine nets is at present allowed.)

Female *T. esculenta* after spawning retire with their broods of eggs and fry to areas in the lake where there is sheltering vegetation. The

* East African Fisheries Research Organisation, JINJA, UGANDA.

Proc. Indo-Pacific Fish. Coun., (III): 97-99, 1958.

young are later released in these areas and move out into more open water where gill nets can be set only when they have reached a length of ten or more centimeters. Knowledge of this behaviour made it possible to recommend the use of gill nets of less than three inch mesh for the capture of other species of fish occurring in the area even though *Tilapia* are the most important element in the fishery. This concession was a significant contribution to a policy designed to make the best use of the various populations of fish in Lake Victoria.

In the early days legislation was introduced prohibiting the use of all gill nets with mesh of less than five inches. Thus it can be seen that knowledge of fish behaviour may allow restrictive legislation to be partially relaxed. The fishermen in Lake Victoria, however, make little use of this concession, as they prefer to fish for the larger and commercially more valuable *Tilapia*.

Arising from work done on the breeding behaviour of *Tilapia*, it became evident that an important factor in determining the supply of recruits to the exploited stocks is a shortage of suitable spawning sites. Experiments were therefore carried out to test the value of breeding numbers of *Tilapia* fry of various species in ponds and liberating them in the lake. It was found that these introduced fry grow well and could form a significant addition to the natural stocks. Furthermore, work on the feeding habits of various species of *Tilapia* led to the discovery that *Tilapia zillii* (a species which does not occur in Lake Victoria) eats rooted vegetation, unlike the indigenous species which feed largely on phytoplankton. There is an abundance of aquatic vegetation suitable for *T. zillii* in Lake Victoria and large numbers of these fish have been introduced and are beginning to establish themselves in a number of areas. It is now generally agreed that a policy of restocking the lake from specially built breeding ponds is worth while. Such positive remedial measures designed to offset the declining numbers of fish could not have been instituted without studies on behaviour.

The statistical analysis of records of fish caught may in turn provide information on fish behaviour. It was found that fleets of gill nets of varying mesh sizes fished regularly in particular areas caught progressively fewer *Tilapia*. It was noted, however, that the rate of decline was least in the nets with the largest mesh used, namely the five inch net. It was possible to deduce from this that whereas the younger fish tend to remain in the neighbourhood of the area in which they were bred, the older fish become nomadic and move around from one area to another. This opinion has to some extent been confirmed by experiments with marked fish. It would seem that the general dispersal of *Tilapia* within the lake and natural restocking of areas where fishing has been intense may depend on the migrations of these larger fish. If large fish survived in numbers below a certain level (yet to be determined) the *Tilapia* in Lake Victoria would most probably be reduced to discrete localised populations.

2. CLARIAS

Clarias mossambicus lives in both open water and in deoxygenated swamps. When living in water containing no dissolved oxygen it breathes by means of its supra-branchial organ. However, the eggs and very young fish survive only in highly oxygenated water.

The abundance of this species appears to be closely related to the availability of suitable inflows in which they can spawn. The sexual cycle of this fish is well adapted to make good use of such opportunities as do arise. While the adults are living in the lakes or coastal swamps they remain in a state of sexual readiness for months at a time. When in this condition the ova are not ovulated and it is not possible to fertilise them artificially. However, as soon as rain falls and these fish are given the opportunity to run up a stream, ovulation occurs within a matter of an hour or so. Under suitable conditions of temperature and oxygen tension the fertilised eggs may develop and hatch in as little as twenty-four hours. This remarkably rapid rate of development can naturally take place only in very well aerated water. However, after three or four days this high rate of metabolism slows down and the young larvae develop accessory air-breathing organs. (These are different from the supra-branchial organ of the fully grown fish). The young larvae, once they have reached this stage, can survive in poorly oxygenated water.

These reproductive arrangements allow these fish to breed successfully in torrents which

flow for only a few days at a time. When one considers the natural hazards that these fish must overcome, it is regrettable to have to record that the local inhabitants, who are aware of the habits of these fish, and of course are able to judge when migration is to take place, place a variety of additional obstacles across the course of the migration.

In anticipation of this run of fish, fences and traps made of reeds are constructed in the water courses and as soon as the run begins all the local population tramp through the moving water spearing the fish. It was surprising to find that many of these people were totally unaware of the significance of this run.

There is little doubt that the numbers of *Clarias* in Lake Victoria could be significantly increased if the Africans could be persuaded to desist from capturing these fish along the course of their migration to the spawning grounds, and until in fact spawning is complete. The traps could quite easily be modified so that the fish could travel up stream yet be caught on their return.

The mouths of the streams down which these spates run and enter the lake are usually blocked with papyrus and other swamp vegetation, so that it is often impossible for the fish to find their way into the stream. It would be to the fishermen's benefit if the mouths of these small streams were kept clear.

Although there is ample food for *Clarias* in Lake Victoria the wholesale destruction of spawning fish prevents the population from growing to a size to make full use of this food. Obviously, therefore, the fishery for *Clarias* could be improved if measures were taken to protect the spawning of these fish.